

STATUS OF THE QUILCENE SPRING CHINOOK RUN

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The protection and rebuilding of spring chinook runs has become an important state, tribal, and federal goal in western Washington. The U.S. Fish and Wildlife Service is attempting to develop a spring chinook brood run at Quilcene National Fish hatchery as part of this interagency effort.

Our goal is to restore this run in Hood Canal by using the Quilcene National Fish Hatchery as an egg bank for outplanting. Before we can outplant, the Quilcene run must be developed to a self-sustaining level. A timetable for meeting these objectives has not been established because of chronic egg shortages.

The size of our program is set forth in the Hood Canal Salmon Management Plan; an interagency agreement between the U.S. Fish and Wildlife Service, the Washington State Department of Fisheries and the Point-No-Point Treaty Council. Under this agreement, after the brood run has been developed, the Hatchery is to release 400,000 spring chinook smolts at 20/lb. and 200,000 at 65/lb. each calendar year into Hood Canal. To maintain these release numbers, a rack return of approximately 500 adults is desirable each year. Priority has been given to yearling (20/lb.) releases since these are thought to have the best survival to adults (Bill Hopley, Washington Department of Fisheries, personal communication).

Our policy since 1981 has been to use Puget Sound stock to the maximum extent possible. If a Puget Sound stock does not meet our egg requirement, we next consider stocks from coastal Washington, and finally from the Columbia River.

PROGRAM HISTORY

Our program began with the 1981 brood year, and releases have been made annually since 1982. Few stocks have been available to support the program. In the 1981 through 1983 brood years, since there were no available Puget Sound stocks, the only available alternative was to cross Nooksack males with Cowlitz females. The Nooksack stock consisted of returns to the Skookum Creek Hatchery on the South Fork and the Kendall Creek Hatchery on the North Fork. Both were derived from native Nooksack brood. The Cowlitz fish were available and were a component in establishing a number of successful Puget Sound spring chinook runs.

We had hoped to continue infusing the Quilcene run with Puget Sound fish by annually crossing Nooksack males with females from the Quilcene returns or from some other stock. However, since the 1984 brood year neither of these stocks has been available. The Cowlitz stock has been unavailable due to the risk of transmitting Infectious Hematopoietic Necrosis from the Columbia River watershed. All available Nooksack stock has been set aside for rebuilding the local Nooksack brood runs. Therefore we have used only the Quilcene rack returns since 1984.

Reasons for Low Hatchery Production

The production goal has seldom been met (Tables 1 and 2) because of either disease outbreaks at the hatchery or lack of broodstock. Although scarcity of egg sources is still affecting production, the disease problem has apparently been resolved.

Broodstock shortages. Outside stocks as well as hatchery rack returns (Table 3) were in short supply. This occurred in spite of our initial expectation that rack returns would supply all our egg needs and eliminate the requirement for outside stock beginning with the 1985 brood year. The 1987 escapement was surprisingly low despite unusually strong three-year-old returns in 1986.

Disease. Bacterial kidney disease severely reduced survival in the 1984 release. Contributing factors were the unforeseeable requirement of the fish for slightly saline water, and the unusual degree of handling due to construction at the hatchery. Disease has not greatly limited production since then because outbreaks are now prevented or controlled by culling infected broodstock, prophylactically injecting broodstock with erythromycin, reducing rearing densities, using a relatively hard freshwater source, adding some water from a saltwater well, feeding antibiotics, and minimizing handling.

A further disease control effort was made beginning with the 1986 release, when the target release size was lowered from 15/lb. to 20/lb. This change reduced prevalence of bacterial kidney disease at release and is also expected to reduce post-release mortality.

Table 1. Releases of spring chinook, by year, into the Big Quilcene River from the U.S. Fish and Wildlife Service Quilcene National Fish Hatchery.

Release year	Releases	
	Approx. 20/lb. (Goal = 400,000)	Approx. 65/lb. (Goal = 200,000)
82	152,245	0
83	155,051	51,928
84	327,297	201,952
85	457,019	0
86	27,695	0
87	215,584	0

Table 2. Releases of chinook by brood year and tag groups. Brood years 86 and 87 are still in the hatchery.

Brood year	Release date	Total release	Size (No/lb)	Stock	Tag code	Percent tagged
81	10/82	152,245	17.3	NF Nook. X Cowl.	5-10-17	16.2
	5/83	155,051	11.9	SF Nook. X Cowl.	5-10-33	17.1
82	6/83	51,928	92.1	SF Nook. X Cowl.	5-14-19	80.5
	3/84	109,764	9.6	NF Nook. X Cowl.	5-13-47	14.0
	3/84	217,833	12.5	SF Nook. X Cowl.	5-13-48	10.7
83	6/84	150,392	67.0	NF Nook. X Cowl.	5-15-54	28.9
	6/84	51,560	69.0	SF Nook. X Cowl.	5-14-26	83.2
	5/85	55,289	10.2	NF Nook. X Cowl.	5-14-52	44.8
	5/85	401,730	17.2	SF Nook. X Cowl.	5-14-53	5.6
84	5/86	27,695	24.2	Quilcene		0.0
85	5/87	28,062	23.0	Quilcene	5-8-32	74.9
	5/87	29,620	23.0	Quilcene	5-14-62	93.2
	5/87	25,875	23.0	Quilcene	5-18-31	88.7
	5/87	26,124	23.0	Quilcene	5-18-32	85.7
	5/87	26,098	23.0	Quilcene	5-18-33	87.6
	5/87	25,391	23.0	Quilcene	5-17-48	85.9
	5/87	24,374	23.0	Quilcene	5-17-49	84.9
	5/87	24,141	23.0	Quilcene	5-17-50	77.2

Table 3. Rack returns, 1983-87, by age and sex.

<u>Return year</u>	<u>Age</u>	<u>Brood year</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>
83	2	81	26	0	26
	3	80	0	1	1
	Total		26	1	27
84	3	81	18	0	18
	4	80	18	15	33
	Total		36	15	51
85	3	82	5	0	5
	4	81	62	70	132
	5	80	2	13	15
	Total		69	83	152
86	2	84	48	0	48
	3	83	113	0	113
	4	82	15	1	16
	5	81	16	52	68
	Total		192	53	245
87	3	84	8	0	8
	4	83	52	32	84
	5	82	6	10	16
	6	81	1	0	1
	Total		67	42	109

Possible Reasons for Low Escapement

Reasons for low return to the rack include low survival from smolt release to adult catch, interception in the mixed-stock fisheries, and poaching in the Quilcene River.

Survival. Low survival between release and catch for several tag groups (Table 4) is suggested by the data from tagging (Table 2) and recovery (Table 5). Very low survival of some groups coincides with water supply and disease problems at the hatchery. For the 1981 broodyear, group 5-10-17 had to be released prematurely due to loss of hatchery water supply. Disease affected the 1984 releases, which included 1982 brood year groups 5-13-47 and 5-13-48. These events could have caused heavy post-release mortality.

Survival of groups not affected by disease or water supply problems also appears low. For example, 0.60% of group 5-10-33 survived to capture or escapement. Group 5-14-19 survived poorly to age 3 and preliminary data (Table 5) suggest poor survival to age 4 as well. This may be due to release as subyearlings.

Table 4. Survival of tag groups from 1981 and 1982 brood years based on 1983-1985 recovery data.

Brood year	Tag code	Tags released	Expanded recoveries					Survival
			Rack	Wash.		BC	Total	
				Sport	Net			
81	5-10-17	24,667	0	0	0	0	0	0.00% to ages 2-4
	5-10-33	26,565	27	51	17	64	159	0.60% to ages 2-4
82	5-14-19	41,808	0	5	5	8	18	0.04% to ages 2-3
	5-13-47	15,367	0	0	0	0	0	0.00% to ages 2-3
	5-13-48	23,232	0	0	10	0	10	0.04% to ages 2-3

Table 5. Expanded tag recoveries from Washington and British Columbia. (Observed recoveries in parentheses.) Data for 1985 and 1986 from Washington and for 1986 from British Columbia are preliminary. Last revised Oct. 30, 1987 from Pacific Marine Fisheries Commission data.

Brood year	Tag code	Rec. year	Rack return	Puget Sound		British Columbia				Central Net	
				Net (a)	Sport (a)	Vancouver Island					
						E. Coast		W. Coast Net, Sport troll			
						Net	Sport				
81	5-10-17	83-86	0	0	0	0	0	0	0		
	(b)										
	5-10-33	83	6(6)	10(2)	0	0	0	0	0		
		84	2(2)	5(3)	7(2)	4(1)	17(4)	0	0		
		85	19(19)	2(1)	44(9)	0	0	37(8)	6(1)	0	
	86		0	0	(1)	0	0	0	0		
82	5-14-19	85	0	5(2)	5(1)	0	0	6(2)	2(1)	0	
		86	0	0	(1)	0	0	10(2)	0	0	
	5-13-47	85-86	0	0	0	0	0	0	0	0	
	(c)										
	5-13-48	85	0	10(1)	0	0	0	0	0	0	
	(c)	86	0	0	0	0	0	0	0	0	
	83	5-14-54	86	0	0	0	0	5(1)	10(2)	0	0
	(c)										
	5-14-26	86	0	0	0	0	0	3(1)	0	0	
(c)											
	5-14-52	86	0	0	0	0	5(1)	0	0	3(1)	
	5-15-53	86	0	0	0	0	0	0	0	0	

(a) Expanded recoveries for 1986 are not yet available.

(b) Released prematurely due to water supply problem.

(c) Post-release survival possibly affected by disease.

For the 1982 and 1983 brood years, complete expanded data are not yet available. Their survival will probably likewise be low, judging from the scarcity of observed recoveries in 1986, especially in Washington (Table 5). Subsequent brood years are expected to survive better since we have improved the rearing conditions. To evaluate the current hatchery practices, we released several replicate tag groups in the 1985 brood (Table 2).

Interception. The British Columbia and Washington fisheries intercepted roughly equal shares of the run, based on 1983-1985 recoveries (Table 4). Within Puget Sound and the Strait of Juan de Fuca, sport fisheries took a larger share of the catch than the net fishery for these years. Most of the Washington catch occurred in northern Puget Sound, and relatively few fish were caught in the Strait (Table 6). A sizeable portion of the sport recoveries came from Hood Canal. The Washington sport fishery caught Quilcene chinook throughout the year but most were caught in the winter (Table 7).

Poaching. Poaching in the Quilcene River has also contributed to low rack returns. The Quilcene run is particularly susceptible to poaching, because the 2.8 miles of river between the hatchery and saltwater are easily accessible, the holding pools are relatively shallow, and the river is very clear for most of the adult holding period. Poaching was reported in 1984 and 1986. Poaching can also explain some of the variability in our biweekly snorkel surveys, conducted each year since 1984. Examples are the apparent disappearance of adults from the river between Weeks 23 and 25 of 1984 and between Weeks 25 and 29 of 1985 (Figure 1). Illegal fishing may also partially explain the high variability in timing among the years.

MANAGEMENT ISSUES

The protection of Puget Sound spring chinook stocks has been attempted through imposition of a maximum size limit. Protection of the Quilcene run has been attempted through sport and commercial closure of Quilcene Bay for chinook. The following observations may aid in evaluating these measures.

Maximum Size Limit

The effectiveness of the 30-inch maximum size limit in reducing sport interceptions has been a concern since 1985. Its purpose was to protect 80% of the four-year-old spring chinook returning to Puget Sound (Kenworthy 1986). This age was chosen because four- or five-year-olds include most of the females, upon which the egg take depends.

Table 6. Distribution of expanded coded wire tag recoveries from Washington, combining return years 1983-1985.

Area	Description	Expanded recoveries		
		Net(a)	Sport	Total
5	Clallam Bay and Sekiu	3	5	8
6	Port Angeles	2	0	2
	Strait subtotal	5	5	10
7	San Juan Islands	4	10	14
8A	Saratoga Passage	14	0	14
9	Admiralty Inlet	0	10	10
10	Seattle	6	10	16
	Puget Sound subtotal	24	30	54
12	Hood Canal	3	21	24
	Washington total	32	56	88

(a) No troll recoveries have been reported in Washington.

Table 7. Distribution and timing of expanded tag recoveries in the 1984 and 1985 sport catch.

Area	Jan	Feb	Apr	May	Jul	Sep	Dec	Total
5			(a)	(a)	5			5
7						6	4	10
9		5		5(b)				10
10	5	5						10
12	9		4	5	5		3	21
Total	14	10	4	10	5	6	7	56

(a) 30" maximum size limit in effect from April 15 to May 31.

(b) Certain days were closed for chinook during this month.

The maximum size limit has covered only Areas 5, 6, and 7, and has lasted from April 15 to June 15. These areas and times have not coincided with the distribution and timing of the limited tag recoveries now available (Table 7). Future tag recoveries are needed to fairly evaluate the portion of the run protected under this restriction.

Within the area covered, the 30-inch limit would protect only 56% of the Quilcene four-year-olds, based on the combined length frequency of rack returns from 1985 through 1987 (Table 8). Lowering the maximum length to 28 inches would probably reach the regulation goal by protecting 80.2% of the four-year-olds, and would protect 92.2% of the females of all ages combined.

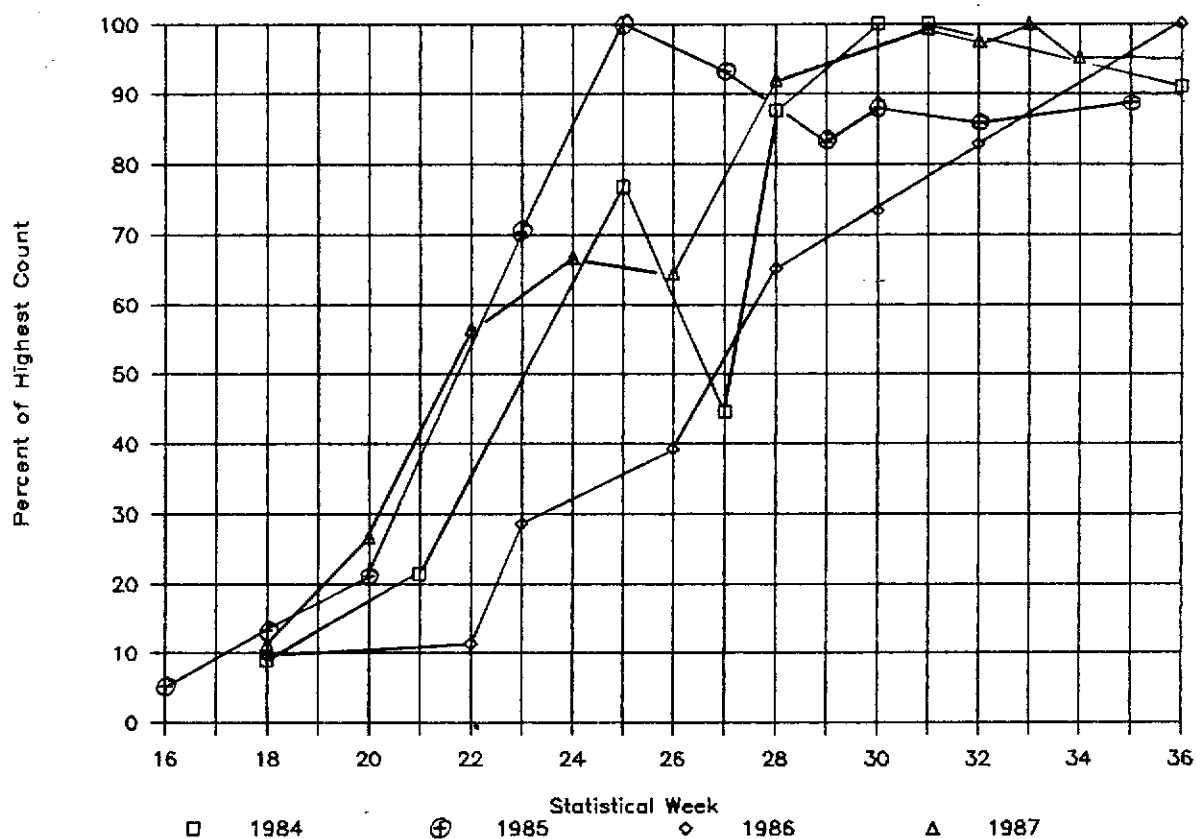


Figure 1. Timing of spring chinook: number observed in the Big Quilcene River, Miles 0.6-2.8, plus number estimated to have entered the Quilcene National Fish Hatchery. Data appear in Appendix Table 1. Typical designation of statistical weeks is:

16	April 13-19	27	June 29-July 5
17	April 20-26	28	July 6-12
18	April 27-May 3	29	July 13-19
19	May 4-10	30	July 20-26
20	May 11-17	31	July 27-August 2
21	May 18-24	32	August 3-9
22	May 25-31	33	August 10-16
23	June 1-7	34	August 17-23
24	June 8-14	35	August 24-30
25	June 15-21	36	August 31-September 6
26	June 22-28		

Table 8. Percent of Quilcene run exceeding various maximum total lengths. Data from Appendix Table 2.

<u>Total length (inches)</u>		<u>Age-4 females</u>	<u>All females</u>	<u>All age-4</u>	<u>All fish</u>
30	Number	64	134	127	220
	Percent	63.4	74.9	55.9	42.1
29	Number	77	149	153	250
	Percent	76.2	83.2	67.4	47.8
28	Number	89	165	182	287
	Percent	88.1	92.2	80.2	54.9
27	Number	95	172	201	313
	Percent	94.1	96.1	88.5	59.8
26	Number	100	177	214	331
	Percent	99.0	98.9	94.3	63.3

Closure of Terminal Area

The closure of Quilcene Bay from April 1 to June 30 since 1985 was intended to limit sport interception in terminal areas. The limited available tag recoveries bring into question the ability of this timing and area closure to protect the run. Most of the Hood Canal sport catch was landed very close to Quilcene Bay, and could have been caught there (Table 6). For example, recovery sites included Jackson Cove, Oak Head, Hazel Point, and Misery Point (Source: Dick OConnor, Washington Department of Fisheries, personal communication). Also, some of the recoveries were made in the winter, long before the bay was closed. More sport catch data are desirable to evaluate the real effect of this restriction.

Terminal area closure seemed more effective when considered from the standpoint of timing in the Quilcene River. The April 1 (Week 14) closure date would protect early-returning individuals if they do not mill very long in Quilcene Bay before entering the river. Figure 1 shows that less than ten percent of the run can be expected in the river prior to mid-April (Week 16). The June 30 (Week 27) opening of Quilcene Bay, however, cannot be expected to completely protect late-returning individuals. For example, in 1986 only about 50% of the run had entered the river by Week 27. In other years the problem was not so severe, and percentages of the run in the river on or before Week 27 ranged from 75% in 1984 to 100% in 1985.

Management Options

Escapements of spring chinook to Quilcene National Fish Hatchery could potentially be increased by any combination of:

- (1) Including Areas 8A, 9, 10, and 12 in the maximum size limit restriction;
- (2) Extending the maximum size restriction to other times of the year;
- (3) Reducing the maximum size limit to 28 inches; and-or
- (4) Extending the Quilcene Bay closure beyond June 30.

We recognize that some of these management options will reduce other sport fisheries in the Strait and Puget Sound. However, the proposed options will likely benefit all Puget Sound spring chinook rebuilding programs.

PROGRAM FUTURE

The contribution pattern of Quilcene spring chinook will receive special attention because this run has been selected as an index stock under the Pacific Salmon Treaty. Data will be used to represent the contribution pattern of naturally-produced fish. Tagging under this program began this year and is expected to be repeated annually. We now tag and release all fish as yearlings. However, release as subyearlings is preferred, to reflect the typical life history of most naturally-produced Puget Sound runs. Changing to subyearling releases at Quilcene may entail a risk of decreased survival to capture, compared to yearling releases. Therefore, this change will only be made upon achieving substantially larger brood runs than we are now getting.

For the next several years we expect increased brood returns due to improvements in hatchery practices. These improvements have progressively reduced pre-release mortality and may reduce post-release mortality as well. The results of these measures will be evaluated from the 1988-1990 tag recoveries and rack returns. Additional escapement may be realized if fishery interception is reduced. In the coming years we expect more tag recovery data which will help all parties to more accurately address the survival and contribution questions regarding the management of this run.

REFERENCE

Kenworthy, B.R. 1986. Progress report of national fish hatchery programming and evaluation activities: Puget Sound and coastal Washington, 1985-86. U.S. Fish and Wildlife Service, Fisheries Assistance Office, Olympia, Washington.

APPENDIX: TIMING AND LENGTH DATA

Appendix Table 1. Timing pattern of chinook in Big Quilcene River, as observed by snorkel survey, and approximate total in Quilcene National Fish Hatchery.

Week	1984		1985		1986		1987	
	River	Hatchery	River	Hatchery	River	Hatchery	River	Hatchery
April 15 16			10	0				
18	5	0	24	1	22	2	13	1
20			36	4			33	0
21	11	1						
22					23	5	62	8
23			99	34	56	14		
24							59	24
25	38	5	133	56				
26					68	28	25	55
27	20	5	87	89				
28	44	5			71	89	30	84
29			56	101				
30	47	9	17	149	53	117		
31	41	15					25	98
32			8	154	47	156	18(a)	103(b)
33							11(a)	112(b)
34							12	100
35			14	154				
36		51		152		245		109

- (a) Based on expanded index counts of total salmon and approximate chinook/coho composition of run.
 (b) Based on counts of total salmon and approximate chinook/coho composition of new arrivals in hatchery.

Appendix Table 2. Length frequency of Quilcene rack returns, 1985, 1986, and 1987 combined.

<u>Total Length (inches)</u>	<u>Age-4 females</u>	<u>All females</u>	<u>All age-4</u>	<u>All fish</u>
10				3
11				6
12				15
13				16
14				8
15				2
16				5
17				12
18			1	17
19			1	32
20				15
21			1	15
22				10
23				7
24		1	5	15
25	1	1	5	14
26	5	5	13	18
27	6	7	19	26
28	12	16	29	37
29	13	15	26	30
30	17	20	35	43
31	19	21	34	38
32	10	24	25	42
33	7	12	14	20
34	4	10	8	18
35	2	12	2	13
36	2	13	4	16
37	3	12	5	17
38		7		8
39		1		2
40		1		2
41		1		1
Total	101	179	227	523